SECTION 800

TRAFFIC CONTROL DEVICES

SECTION 801

CONDUIT, MANHOLES, HANDHOLES, PULL BOXES AND FOUNDATIONS

DESCRIPTION

801.20 General.

The work under this section shall consist of furnishing and installing and/or constructing the following in accordance with the requirements of the specifications, as directed on the plans and as directed by the Engineer.

A. Unless otherwise specified or indicated on the plans conduits or ducts, intended for use as raceways for the installation of wires and cables, shall be 80 millimeters nominal size.

1. Type NM – Rigid Non-Metallic (Plastic) – shall be used for all underground runs unless otherwise specified.

2. Type RM – Rigid Metallic (Steel, Steel Plastic Coated, Special Alloys or Aluminum) – shall be used for all above ground runs, unless otherwise specified, and where augured or jacked conduit is required. When specified for underground use or to be encased in concrete, conduit shall be plastic coated or manufactured from metal inherently resistant to corrosion.

3. Type FM – Flexible Metallic (Steel or Steel Plastic Coated) – shall be used where flexibility and special applications are required.

B. Junction Boxes or Pull Boxes shall be of such dimension as shown on the Standard Drawings. Unless otherwise specified, other designs shall not be used. Pull Boxes shall be installed in all conduit or duct runs over 50 meters in length, where there is an abrupt change in direction, grade or elevation, to provide a direct one conduit entrance for wire and cable into signal, mast arm or strain pole foundation, and as directed by the Engineer.

C. Electric Manholes as shown on the Standard Drawings, plans, and/or as directed by the Engineer.

D. Foundations for light standards, lighting load centers, standard signal posts, pedestal signal posts, mast arms, strain poles and control cabinets.

MATERIALS

801.40 General.

Materials shall meet the requirements specified in the following Subsections of Division III, Materials:

Cement and Cement Concrete Materials	M4
Pipe, Culvert Sections, Conduit and Fittings, Pull and Junction Boxes	M5
Paint and Protective Coatings	M7
Metal, Related Materials, Cast Iron Frames and Covers	M8
Gravel	M1.03.0, Type c

Metallic pull and junction boxes may be cast iron, welded sheet steel or cast aluminum, with gasketed covers securely fastened with monel or stainless steel screws that will, with cover in place, be watertight. Cast iron or sheet steel boxes shall be hot dipped galvanized conforming to the applicable portions of ASTM A 153.

CONSTRUCTION METHODS

801.60 Conduit.

A. Excavating Trench.

The conduit shall not be placed until after the gravel subbase for the roadway has been constructed and the rolling thereof has been completed.

The trench for a single conduit line shall be excavated to a width of 500 millimeters to a depth not less than 1 meter below the proposed grade of the finished pavement as shown on the plans. Whenever 2 or more conduit lines are to be laid in the same trench, the trench shall be excavated to the width shown on the plans or as specified in the Special Provisions. If the condition of the bottom of the excavated trench is wet, clayey or spongy, or otherwise unsatisfactory, the Engineer may require that the bottom of the trench be excavated deeper and the space filled with clean gravel to form a firm bearing for the conduit. The gravel shall be firmly compacted in layers not over 150 millimeters in depth. The grade of the finished trench shall be parallel to the proposed pitch of the traffic conduit or duct.

B. Preparation of Bed.

After the trench has been excavated to the proper width and depth as specified above, a gravel foundation 150 millimeters in depth shall be constructed on the bottom of the trench to provide a proper cushion for the conduit. This cushion of gravel shall be thoroughly tamped.

C. Laying Conduits.

Unless otherwise directed, all conduit lines shall be direct from one end to the other, no bends being allowed except when entering a pull box or signal base. Whenever 2 or more conduit lines are to be laid in the same trench, the conduits shall be separated from each other by a minimum distance of 75 millimeters.

D. Joints.

All joints shall be made in accordance with conduit or duct manufacturer's recommendations, NEMA, UL and the Massachusetts Electrical Code (MEC).

E. End Markers.

Dead ends of conduit lines shall be plugged with wooden, plastic or fibre stoppers. To mark the ends, sections of 50 millimeter by 100 millimeter studs, long enough so as to project above the surface of the ground after the trench has been backfilled, shall be set vertically before the backfill is placed. For single conduit lines, the stud shall be butted directly against the stopper in the end of the conduit. Where 2 or more conduit lines converge to a common point, each line shall be ended 600 millimeters from the common point of intersection and a stud set up at this point. Backfill shall not be placed until the Engineer has established the necessary ties to the studs.

F. Concrete Envelope.

All Type NM Conduits or ducts marked "X" on the plans shall be encased in a concrete envelope as shown on the Standard Drawings.

G. Filling Trench.

Gravel fill shall be made around the sides of the conduit and over it for a depth of 75 millimeters and thoroughly tamped. A plank of spruce, fir, hemlock or other satisfactory wood, about 150 millimeters wide and
50 millimeters thick (nominal dimensions) shall be placed over this gravel and the filling of the trench with suitable materials in layers of not over 150 millimeters, compacted thoroughly, shall be completed. If Extra Heavy Wall (Schedule 80) Conduit is selected as an option for Rigid Non-Metallic Conduit, an approved underground warning tape may be substituted for the 50 millimeter by 150 millimeter plank.

H. Testing Installation.

After the trench is backfilled, the Contractor shall, in the presence of the Engineer, test the installation by pushing or pulling through the entire length of the conduit line a rod, rope or fish tape on the end of which is attached a brush and ball with a diameter not smaller than 6 millimeters less than the inside diameter of the conduit. All obstructions, including stones, dirt, concrete, etc., shall be removed, and damaged conduits shall be replaced at the expense of the Contractor.

I. Conduit and Duct Crossing Paved Roadways.

Unless otherwise specified, when a trench has been cut across a paved surface, the trench shall be bridged with a 150 millimeter concrete slab as shown on the Standard Drawings.

When jacking or drilling methods are specified for placing conduits under existing pavements, pavement shall not be disturbed without the approval of the Engineer. In the event obstructions are encountered, upon approval of the Engineer, small test holes may be cut in the pavement to locate the obstructions. Jacking or drilling pits shall be kept 1 meter clear of the edge of any type pavement wherever possible.

J. Conduit on Structures.

Conduit system on structures shall consist of furnishing and installing all material and equipment and performing all work necessary for a complete conduit system. The type of conduit shall be as designated on the plans conforming to the requirements of Subsection M5.07.1. All conduit bends shall be made in a neat and workmanlike manner; crushed or deformed conduit shall not be used. Conduit ends shall be reamed to remove all burrs, and all chips resulting from reaming removed from the conduit before installation. The ends of all conduit runs shall be protected by grounding bushings and be capped if wire and cable is not to be installed immediately. Conduit shall be held rigidly in place to prevent misalignment during placing of concrete. Reinforcing bars shall not be cut, bent, displaced or otherwise altered from that shown on the design plans, unless directed otherwise by the Engineer. One manufactured expansion fitting (made of material compatible with the conduit) shall be used for each conduit run on structures at every expansion joint of the structure, unless flexible metallic conduit loops or bends are stipulated. Clamps or hangers shall be provided at intervals not exceeding 1.5 meters.

Conduit runs shall be made with the minimum practicable number of bends. The total of the angles of bends between junction or pull boxes shall not exceed 270°. So far as practicable, all bends shall be formed by the use of factory standard radius elbows. For metal conduit, where special angles of bends or offset bends are required, they may be formed to a radius of not less than 6 times the nominal inside diameter, provided the bend is made on a pipe bending machine. Field bends may be made by the use of a conduit bender forming curves the minimum radius of any portion of which shall not be less than 12 times the nominal inside diameter. Short radius bends shall be accomplished by the use of junction boxes or special condulets. Hot bends or other methods of bending which will destroy the protective coating on the metal conduit will not be permitted.

Conduit in which the cross sectional area has been reduced or which contains sharp kinks will be rejected. Unless the plans indicate otherwise, conduit shall be continuous from outlet to outlet: however, the runs may be interrupted by condulets placed for the purpose of pulling conductors or making short radius bends. All metal conduit shall be cut square, the ends internally reamed and threaded the proper length and assembled at all fittings in proper manner so that all joints will be mechanically secure, water tight, and provide electrical continuity. All threaded connections shall be given a coat of pipe joint compound before fitting up.

The ends of field cut joints on non-metallic conduit, except plastic, shall be tapered to conform to factory ends. The sections shall be joined at couplings and fittings by tapping the ends of sections sufficiently to provide water tight joints without over stressing or cracking the fittings. Where non-metallic conduit is joined to metallic conduit, special tapered and threaded non-metallic adapters shall be used. When fitting-up compound is specified for non-metallic conduit the compound shall be of a type which will remain plastic during assembly and set within a reasonable period thereafter. The compound shall be carefully painted on joints so that excess compound will not intrude on the inner surface of the conduit after assembly.

All junction boxes shall be of sufficient size to provide for proper splicing and packing of all conductors, plus additional space for a future increase of 50% in the number of conductors or conductor size.

All unused openings in boxes and fitting shall be closed by tight metal plates or plugs and all dead ends of conduit, except where provided for drainage, shall be fitted with pipe caps.

All terminal ends of conduit not ending in boxes or condulets shall be fitted with rubber bused caps containing the required number and size of holes to tightly fit the conductors running through, or fitted with standard water tight terminal fittings or pot-heads.

Where an obstruction may have developed in any conduit run, it shall be removed, if practicable. If the obstruction is not removed, the affected portion of the conduit system shall be removed and replaced with new, clean conduit, or, if this cannot be accomplished, an entire new conduit shall be placed around the affected section at a location selected by the Engineer.

All conduit encased in concrete shall be rigidly held in proper position during concrete placement. Non-metallic conduit shall be secured against separation at the joints during concrete placement by being tied to a separate steel rod at least 13 millimeters in diameter running the full length of the conduit. Such rod and ties shall be considered as parts of the electrical installation.

Provisions for adequate drainage shall be made in all conduit systems. Horizontal runs shall be slightly pitched and unless completely sealed against moisture, all low points shall be drained.

Conduit shall be adequately supported by sleeves, fixed boxes, hangers, clamps, or anchorages placed at intervals not exceeding 1.5 meters. Anchor bolts which are indicated on the plans as set in concrete shall be placed in the proper location before placing concrete.

Condulets, pull boxes, junction boxes and caps shall be of galvanized cast or malleable iron, of the threaded connection type with cast waterproof covers fitted with moisture proof gaskets. The covers of junction boxes which house

transformers or cutouts shall be attached to the box by hinges or chains.

Conduit or raceway sleeves shall be placed during construction of the portions of the structures in which they are located. They shall be maintained in a clean condition and protected from damage or obstruction by placing removable plugs or caps until ready for use.

In general, exposed conduit shall not be placed until all adjacent construction work has been completed. Portions of conduit to be encased in masonry, or boxed in between structural members, shall be placed in advance of placing concrete or during assembly of structural members and protected from damage and plugging by use of covers or tight fitting metal caps.

801.61 Electric Manholes, Handholes, Pull Boxes and Junction Boxes.

A. General.

Electric manholes, handholes, pull and junction boxes shall be built to the lines, grades, dimensions and designs shown on the plans or Standard Drawings with the necessary frames, covers, etc., in accordance with the applicable provisions of Section 201, Basins, Manholes and Inlets.

B. Cast in Place Concrete Units.

After excavation, all loose material shall be removed before the forms are installed. All conduits, ground rods, pulling irons and reinforcing steel shall be installed rigidly in place before the concrete is placed. After the concrete for the manhole, handhole or pull box is placed, and forms removed, all exposed portions of the concrete shall be neatly finished. Frame castings shall be set according to the requirements of Subsection 201.63, Placing Castings.

C. Pre-Cast Concrete Units.

The construction methods for pre-cast concrete units shall conform to the relevant provisions of Section 901, Subsection M4.02.14 and the above Subsection 801.61-B.

D. Metallic Units.

Metallic pull and junction boxes shall be installed at the approximate locations shown on the plans, or in long conduit runs, they shall not be spaced over 50 meters from each other. It shall be the option of the Contractor, at his/her expense, to install additional pull or junction boxes that he/she may desire to facilitate his/her work.

Pull or junction boxes installed shall not be of dissimilar metal to the metal conduit used in any one electrical system.

801.62 Foundations.

Light standard, lighting load center, signal post, strain pole, signal mast arm and signal control cabinet foundations shall be constructed with the necessary anchor bolts (supplied under the items listed in Section 815 Traffic Control Signals, Section 820 Highway Lighting, and Section 824 Flashing Beacons, Illuminated Warning Signs and Lighted Barrier Arrows), reinforcing rods, conduit elbows or sweeps, etc., as shown on the Standard Drawings, and in accordance with the applicable requirements of Section 901 Cement Concrete Masonry.

For core type foundation estimating and bidding purposes, in the absence of boring samples, or the actual determination of the soil properties at the proposed footing location, the Department will accept an assumed soil bearing pressure of 100 kiloPascals for the design of the footing using the Span Wire Assembly Design Chart III of the Department's Standard Drawings. The moments shall be calculated from the data obtained from the relevant traffic control signal plan.

However, the augered foundations shall not be constructed prior to soil classification of the subsurface soil by a qualified firm or person to perform the soil classification, analysis, and footing design.

The actual existing soil conditions shall be determined from boring samples (see Section 190). If the results of the auger boring show that the soil classification requires the use of a Foundation Design Chart that requires a greater depth the foundation shall be constructed according to the requirements of the appropriate chart and payment will be made for the difference in depth under Item 815.98.

Inversely, if it is determined the soil classification permits the use of a Foundation Design Chart that requires a lesser depth, the Department shall be credited for the difference in depth under Item 815.98.

All unsuitable material within the limits of the footing must be removed at the direction of the Engineer (Peat organic material, material that has been dumped, etc.).

The concrete for the footing shall be placed immediately after excavation to prevent water from collecting in the excavated area.

COMPENSATION

801.80 Method of Measurement.

When separate items are listed in the Proposal for various types of Electrical Conduits each type will be measured according to the following:

Electrical Conduits of each kind and diameter will be measured by the meter between end terminals along the center line of the conduit as actually installed, complete in place and accepted. When conduit ends terminate in pull or junction boxes, measurement shall be to the center line of such pull or junction boxes.

Electric manholes, handholes, pull and junction boxes, and signal and lighting foundations shall be measured for payment as a unit.

Allowance for rock, if not already paid for under previous rock excavation, shall be based on the width of rock encountered in the trench but not to exceed the width specified in Subsection 801.60. Structure excavation shall be measured in accordance with Section 201.

The measured quantity (including a 150 millimeter depth allowance) will be paid for under the item for Class B Rock Excavation.

Gravel will be measured by the cubic meter as specified in Subsection 150.80.

Cement Concrete Masonry will be measured by the cubic meter as specified in Subsection 901.80.

801.81 Basis of Payment.

The unit contract price per meter shall be full compensation for furnishing all conduits, condulets, couplings, expansion fittings, elbows, bends, caps, sleeves, clamps, hangers, reducers, tees, jointing compound, sealing compound, cement concrete required in Subsection 801.60-F and 801.60-I, planking required in Subsection 801.60-G and gravel required in Subsection 801.60-B; for placing the electrical conduit in accordance with these specifications, including all excavation (except Class B Rock Excavation) or jacking required, backfilling of the trenches, chipping or sawing of pavement, bedding or hanging of conduit and all other work incidental to the construction of the conduit system, except that when electrical conduit is included on any project as an integral part of a traffic control signal or Highway Lighting System and the conduit is not shown as a pay item, it shall be considered as incidental to the construction and be included in the lump sum price for such systems.

The accepted quantities of signal and lighting foundations (including anchor bolts) will be paid for at the contract unit price each.

Anchor bolts will be paid for under the items listed in Sections 815.82 and 824.82.

The accepted quantities (including cost of castings) of electric manholes, handholes and pull and junction boxes will be paid for at the contract unit price each, complete in place.

Any incidental work or materials for which no basis of payment is provided will be considered as completely covered by the unit price bid.

Class B Rock Excavation will be paid for under Item 144. The contract unit price shall be considered full compensation for the satisfactory disposal of the Class B Rock excavated material.

Borings will be paid for in accordance with Section 190.81.

801.82 Payment Items.

801.051 to 801.156	*___ millimeter Electrical Conduit Type NM (#) (*50 mm to 150 mm diameter) (# single, double, 4 bank, or 6 bank)	Meter
804.105 to 804.150	*___ millimeter Electrical Conduit Type NM - Plastic (UL) (*15 mm to 150 mm diameter)	Meter
805.05 to 805.15	*___ millimeter Electrical Conduit Type NM - Plastic (NEMA) (*15 mm to 150 mm diameter)	Meter
806.15 to 806.150	*___ millimeter Electrical Conduit Type RM - Steel (Galvanized)	Meter
807.015 to 807.150	*___ millimeter Electrical Conduit Type RM - Aluminum (*15 mm to 150 mm diameter)	Meter
808.05 to 808.15	*___ millimeter Electrical Conduit Type RM - Steel (Plastic Coated)	Meter

	(*50 mm to 150 mm diameter)	
809.015 to 809.100	*___ millimeter Electrical Conduit - Flexible Metallic	Meter
	(*15 mm to 100 mm diameter)	
810.	Conduit Encased in Concrete - SD4.041	Meter
811.10 to 811.14	Electric Manhole - SD2.0* (* SD2.010 to SD2.014)	Each
811.20 to 811.24	Electric Handhole - SD2.0* (* SD2.020 to SD2.024)	Each
811.30	Pull Box 200 millimeters by 585 millimeters - SD 2.030	Each
811.31	Pull Box 300 millimeters by 300 millimeters - SD 2.031	Each
811.35	Pull Box Adjusted	Each
811.36	Electric Manhole Adjusted	Each
811.37	Electric Handhole Adjusted	Each
811.40 to 811.52	Junction Box ___ x ___ x ___ millimeters	Each
812.10 to 812.15	Light Standard Foundation SD3.01* (* SD3.010 to SD3.015)	Each
812.20	Lighting Load Center Foundation	Each
812.30	Standard Signal Post Foundation	Each
812.31	Pedestal Signal Post Foundation (SD3.031)	Each
812.40	Signal Mast Arm Foundation	Each
812.50	Signal Control Cabinet Foundation	Each
815.98	Footing Cost Adjustment	Meter
144.	Class B Rock Excavation	Cubic Meter
191.	Drive Sample Boring	Meter
191.11	Core Boring	Meter
193.	Mobilization and Dismantling of Boring Equipment	Lump Sum

SECTION 813

WIRING, GROUNDING AND SERVICE CONNECTIONS

DESCRIPTION

813.20 General.

This work shall consist of furnishing and installing wire and cable of the type and size indicated for traffic signals, highway lighting and related electrical systems, equipment grounding systems, new ground electrodes or connections to existing ground electrodes and all materials and equipment necessary to deliver power to traffic signal, highway lighting and related electrical systems.

Service points shown on the plans are approximate only. The Contractor shall determine exact locations and riser elevations from the serving utility, arrange to complete the service connections and be responsible for all charges incidental thereto.

All electrical connections, splicing, grounding, resistance tests, service connections and circuit identification shall be done by a licensed electrician holding “Certificate B” issued by the State Board of Examiners of Electricians.

813.21 Cable Types and Uses.

A. General.

The types of wire and cable shall be used in the following manner:

Type 1 – All traffic control signal circuits above ground supported by a messenger wire, in duct or other electrical wire and cable raceway and shall be installed only when the air temperature is above 2 °C.

Type 2 – Same as Type 1 except may be installed at any air temperature above -6 °C.

Type 3 – All traffic control circuits installed above ground supported by integral messenger.

Type 4 – Same as Type 3 and when an electrical continuous metallic shield is required.

Type 5 – All traffic signal circuits for direct earth burial or severe service conditions.

Type 6 – Traffic control signal heads.